Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

PUBLIC HEALTH REPORTS

VOL. 34 AUGUST 22, 1919 No. 34

THE MALARIA PROBLEM OF THE SOUTH.[1]

By H. R. CARTER, Assistant Surgeon General, United States Public Health Service.

The hot countries are preeminently the home of protozoal infections, and in the southern parts of the United States one such disease, malaria, stands foremost for the injury it does. In that section not one of the bacterial diseases is in its class in this respect, not even excepting tuberculosis. And here, let me say, that in making this statement, I am only considering such parts of the South (and Southwest) in which malaria prevails *to such an extent as to create a serious sanitary problem.* In many sections of the South it is no problem at all; in many others it is a very minor problem; but in those sections where it is really prevalent, the question of malaria easily constitutes the most important sanitary problem with which we have to deal. There it stands first on the list for the injury which it does the community.

It is true that malaria does not give the highest or even a high mortality. Tuberculosis, pneumonia, and typhoid fever run well above it. But is recorded mortality an accurate measure of the comparative injury done by disease? If it were, tonsillitis and Riggs disease would be considered harmless. One of our southern health officers says: "We must direct our work against that group of diseases which gives the heaviest mortality, because the reduction of mortality is, in the last analysis, the measure of our success." I count him wrong in his standard of success; doubly wrong if he understood "mortality" to be the same as "recorded mortality." The recorded mortality of a disease frequently does not indicate its true influence on the death rate. This is eminently true of malaria. From its effects, physical and economic, in lowering the general vitality of a community, it is a causal factor in many a death in which it is not the *terminal* factor, the one recorded as the "cause of death." *Mortality statistics do not, then, give the proper weight of this disease as a cause of death.*

It is not in its death rate that the gravest injury of malaria lies: It is in its sickness rate, in the loss of efficiency it causes, rather than in the loss of life. One death from pneumonia ordinarily corresponds to about 125 sick days—work days lost; one from typhoid fever to 450 to 500 sick days; one from tuberculosis to somewhat more than this among whites, decidedly less among negroes. A death from malaria, however, corresponds to from 2,000 to 4,000 sick days. This loss of efficiency may really be doubled or trebled, for the man infected with malaria is frequently half sick all the time.

---

[1] From an address delivered at the Conference of Sanitary Engineers, Wilmington, N. C., Feb. 17, 1919.

And it is the *amount* of *malaria* when it is bad which appalls. If 1 per cent of the population is stricken with typhoid fever, it is an epidemic and a bad one. Contrast this with 40 per cent to 60 per cent of a population per annum affected with malaria, and I have seen outbreaks with 90 per cent, and you gain some idea of the importance of this disease. The loss of efficiency caused by malaria in the country of the malarious section of the South is beyond comparison greater than that caused by any other disease, or even by any two or three diseases combined, including typhoid fever and tuberculosis.

I am not speaking at random. You have never heard of the prevalence of typhoid fever determining the failure to locate industrial plants. Yet, at one place where power from a hydroelectric plant was abundant and very cheap, the manager told me that a number of options for cotton mills, wagon factories, etc.—options which had been taken because of the cheapness of the power—had been abandoned because of the prevalence of malaria.

Has the presence of tuberculosis ever prevented a real estate transaction? I know of a deal involving the purchase of a large tract of land for colonization—a tract valued at about a half million dollars—not consummated on account of the prevalence of malaria in that section, and there was not much malaria either. You have not seen homes abandoned because of either tuberculosis or typhoid fever. I can assure you that I have seen them abandoned on account of malaria.

The importance of the problem, especially as compared to that of other preventable diseases, has not been recognized, and the reason is plain. The sections in which malaria is not prevalent are, partly for that very reason, the most progressive, and, hence, have the best paid and most efficient health organizations. The sanitarians of those organizations are naturally the leaders in sanitary thought for the United States. Malaria is not among their problems, or if so, it is a minor one, and they lay stress on other problems. Influenced by their writings, the comparative importance of health problems for the South and Southwest has not been rightly appreciated by the sanitarians of these sections. I say *has* not advisedly, for it is coming to be appreciated now.

Another thing which has obscured the sanitary importance of malaria is that the most progressive local health officers of the South, and indeed everywhere, are those of the cities. These men write and speak at conventions—and they write and speak well—and they profoundly influence the sanitary opinions of those who meet them. Now, malaria is not a city disease and it is not one of their problems, and those men in the South itself to whom others look for sanitary leadership are not directly concerned with the most serious problem of the rural districts. I speak from personal knowledge.

Yet another reason is to be found for the nonrecognition of the importance of the malaria problem in the fact that we are so used to malaria. In some sections people are expected to have chills "off and on" for the early years of life, and the occurrence of this disease is looked upon as a matter of course. After childhood an immunity is acquired and the disease is less common, but the child has been handicapped during the time he was growing and getting his education.

Area of Prevalence.

One encouraging fact about malaria in the United States is that the area of prevalence, certainly the area in which it is severe, is lessening. In eastern North Carolina there is not now one-third of the malaria there was in the eighties. I think the same is generally true, though, perhaps, not to the same degree, in all of the cotton States. On the other hand, it has increased in some sections of these and other States.

The reasons for this decrease are interesting and instructive. Primarily, the decrease is due to the rise in the price of cotton and the fall in the price of quinine. The first has led to prosperity for the farmer—and all are farmers here; to better living conditions; to the clearing and draining of more land; and to better clearing and better drainage. (I count drainage, especially tile drainage, the key to the rural malaria problem.) The action of the second causative factor is obvious.

The lessening of malaria due to the prosperity of the farmers reacts, through sequence, favorably on itself. As the people become healthier their energy increases and they become still more prosperous; consequently, more land is put in cultivation and drained, cultivation is cleaner and drainage is better, the houses are screened, and malaria is thus further reduced. And so it goes, forming an endless chain of improvement in which health and prosperity are alternate links. This I was happy to see in many places in the South and Southwest, and I noticed it especially in North Carolina.

Conveyance.

Without going into the question of the conveyance of malaria by the mosquitoes, I will lay down a few postulates:

1. Malaria is caused by parasites in the blood of the person suffering from it. Persons with such parasites in their blood are infected with malaria.
2. Those parasites were injected into the person by the bite of a mosquito infected with the parasite. Man receives infection in no other way.
3. The mosquito herself received this infection by having previously fed on a person whose blood contained such parasites. The mosquito acquires infection in no other way.
4. The only mosquitoes which are infected with malaria are those of the genus Anopheles, and not all species of Anopheles are efficient carriers of malaria.

The change from man to the mosquito and back again is necessary for the continuous existence of the parasites, just as necessary as that change for the germ of wheat by which it is alternately in the ground and in the air. The malaria parasite can not live indefinitely in the mosquito; it can not live indefinitely, although much longer, in man. Without this continued change between the two hosts the parasite dies. This, then, gives us our clues for malaria control: (1) Keep infected mosquitoes away from man; or (2) keep mosquitoes away from infected men. The control of either host—the mosquito or the man—will eliminate malaria.

Methods of Malaria Control.

Briefly, our methods of malaria control aim to—

1. Get rid of Anopheles mosquitoes—no other kinds make any difference in malaria.
2. Prevent the access of Anopheles mosquitoes to man.
3. Free all persons in the community from malaria parasites.
4. Protect persons against infection by means of quinine.

So far as the first and second points are concerned no further explanation is necessary.

So far as the third point is concerned it is clear that if all men were free from malaria parasites there would be no way of infecting mosquitoes, and unless infected they can not transmit malaria.

Finally, if men are put in such a state that they can not develop malaria even if bitten by mosquitoes, naturally malaria will be controlled. This it is attempted to do by means of protecting or immunizing doses of quinine.

The first two methods aim at control of the mosquito; the last two, control of the human host. The first and third are community methods; the second and fourth individualistic, but they overlap in this respect.

Which is the best method? There isn't any best method; or, rather, each one of them may be best under certain conditions. Let me explain: Theoretically, the first method—getting rid of mosquitoes—is absolutely effective. Moreover, it has been proved at Port Said, at Panama, and at a dozen places in the United States, that if the production of Anopheles mosquitoes is controlled, malaria is controlled or eliminated. Furthermore, it is always physically possible to control the production of these mosquitoes. Why, then, should we consider any other method? Because it is not everywhere that this production can be controlled within the *allowable economic limit.*

I will not go into the methods of controlling Anopheles production. They rest on the destruction of breeding places by (*a*) removing, by draining or filling, the water in which they breed, or (*b*) rendering it unfit for breeding, by current, oil, larvicides, fish, etc., or a combination of them.

Although not the only method of malaria control, and in some cases not the advisable method, the control of Anopheles production is the one depended on in most of the work heretofore done in the South, quite frequently with screening (itself an antimosquito measure) as an adjuvant. In my opinion, whenever the control of Anopheles production is not prohibited by the cost, it is the method of choice. It has these advantages:

(1) The main work is done once for all and the upkeep is usually small.

(2) The work is done with materials—earth, water, etc.—and not with people. Health officers will know that no material is so refractory to work with as people.

(3) Both the installation and the upkeep are carried out directly under the supervision of the health officer, and the result can not be vitiated by individual carelessness, crankiness, or bad faith.

Compared with the individualistic methods, this method is like a municipally-sterilized water supply compared with individually-sterilized drinking water. The former gives the heaviest cost, but it is the least troublesome and, to the community, is the safest. It is very generally applicable to villages and thickly settled communities; less frequently applicable to sparsely settled districts. The reason is obvious: The expense of control of mosquito production in a community is roughly proportional to the *area* of breeding which lies within the limits of flight to the dwelling section of that community. The benefits of such control, and, hence, the funds allowable to spend on it are proportional to the population. It is obvious, then, that *the expense per head for this work increases and decreases inversely as the population per unit of area.*

In practice where we have tried it for villages and closely settled communities it has not proved costly—at least, I hope you will not think so—for the results obtained. Let me give you some figures:

Roanoke Rapids, N. C., is a mill village, or rather a group of mill villages, with a total of over 4,000 population. Prior to the malaria work the population was continually changing. Wages were good, work was abundant, and people came, but they developed malaria and would not stay. The mill managers estimated the efficiency of their employees at from 40 to 60 per cent during the four unhealthful months. During this time machines were constantly idle. The mill physicians, who attended employees without charge, averaged during the summer months for 1912 and 1913, fifty calls per day for malaria. During 1914, the first year of malaria work (control of mosquitoes was depended on), there were still a few cases (33) of malaria, relapses from 1913. The efficiency rate rose to 90 or 95 per cent, and the average number of calls for malaria for the same months was three daily. In 1915 there was no question of efficiency to be considered—it was normal. The average of doctors' calls for malaria was 1 in three days. All these were in newcomers and were believed to have been contracted elsewhere.

One of the millmen writes: "The money spent in your campaign against malaria here gave the quickest and most enormous returns I have ever known from any investment." It did pay in the first year from 100 to 400 per cent.

The cost here was 80 cents per head for the first year and 27 cents per head for the second year. The efficiency of the mill was raised from 50 to 100 per cent (normal).

Wilson, Va., is a community only moderately thickly inhabited, not a village. It has been subject to malaria for many years, ever since it was settled, I presume, and of late years the conditions had been getting worse. In 1915 they were bad. Every house I visited in early October had a sick inmate and in some houses there were several. No record of cases was kept, but there were 5 deaths in August, which should correspond to at least 500 cases. The work was expensive and the community, poor on account of malaria, had to be helped. With what was done by the railroad (partly for economic reasons, because the work pays for itself), it cost about $12 per head. Exclusive of this the cost was $3.40 per head, which is very high.

Yet, only one single case of malaria, a relapse, appeared there this year and I judge the work was worth its cost. It is the best result I have ever known. Next year it will not cost over 25 cents a head—except for repairs to screening, which would be done anyhow for comfort's sake. Wilson was costly because the area to be handled was sparsely settled and it was, therefore, not a good place in which to make a showing. Now let us turn to a larger town where we can make a better showing in cost per head.

Crystal City, Mo., has 8,000 population. The expense here was $7,080. An unnecessary error in cutting the ditches made the cost somewhat greater than it need to have been. So far as the results are concerned the health officer states that malaria was reduced from 80 to 90 per cent. A sickness-insurance company paid in this town, in 1915, benefits to 12½ per cent of its policyholders and in 1916 to 2.9 per cent. This would give a reduction of from 75 to 80 per cent which, counting the usual relapses, should mean a reduction of from 90 to 95 per cent in cases contracted in 1916. The expense was 88½ cents per head, though it should have been decidedly less. Next year it will be not over 25 cents per head.

I could cite you a number of cases like these. In Crossett, Ark., for example, there was a reduction of malaria for the summer of 1916 from 1,650 cases to 288, which is equivalent to a reduction of 82½ per cent. The September ratios, when most of the relapses are eliminated, are 600 and 46—a reduction of 92½ per cent. This reduction was still further increased in 1917. Derivaux, of the United States Public Health Service, and Taylor, of the International Health Board, did this work, which was financed by the Rockefeller Foundation. It is as good work in malaria as had ever been done anywhere.

I will not have time to more than mention the other methods. Screening has been used where control of production of Anopheles mosquitoes was impracticable, and has given good results, but not so good as those obtained from the latter method.

A demonstration of the third method, that of freeing all persons in a community from malarial parasites, was undertaken in 1916 and 1917 by the Rockefeller Foundation at Bolivar County, Miss. This work was carried on under the supervision of Dr. Bass, of New Orleans, and Dr. Leathers, the health officer of Mississippi. I understand that it was successful, but do not know the details.

Quinine immunization has not been tried out scientifically on a large scale in the United States, for, excepting, possibly, the work done in Bolivar County, above alluded to, nowhere in the United States has this method been extensively employed.

Under our political organization the Federal Government can not do antimalaria work as described above except as a demonstration. Demonstrations we have made, and it has been our aim to show communities:

(1) That control of malaria is feasible;
(2) That control of malaria is profitable;
(3) And, finally, how to control malaria.

When the above is known and really *believed*, the people will go to work, each unit for itself, and the problem of malaria control will be in the way of solution.

Quite a number of demonstrations were made by the United States Public Health Service during the three years preceding the war. The service makes the malaria survey, plans the work in detail, and supervises it as much as is necessary or possible. The communities mainly bear their own expense, the industrial companies in them contributing the greater share. One State (Virginia) has helped finance demonstrations carried on within its bounds. These demonstrations were made at Wilson and Emporia. No other State, so far as I know, has done so. The Rockefeller Foundation, through the International Health Commission, has financed two demonstrations in Arkansas. They have all been successful, eminently so, and not costly. They were made to prove the value of antimosquito work for the control of malaria in the United States; and, if I am a judge, they have proved it.

The advantage of a demonstration in a community is that, if it be a real success, it induces neighboring communities to emulate it and may lead to a very considerable amount of malaria-control work. No community has ever abandoned the work when once it had felt its benefits.

In addition to the demonstrations spoken of, we have visited many places as consultants, so to speak, making malaria surveys—to get a knowledge of the condition of the community and thereby determine what is needed—then giving advice and drawing up plans for the control of malaria, but without following out the actual work to the extent of making it a demonstration. Some of these communities do good work; some do nothing. We have now, however, pretty well learned from which communities results can be obtained, and do not lose much time on the others. We did not know at first.

Some of these consultations have been made in connection with rather extensive drainage projects, in order to control malaria as much as possible while the land was being made suitable for agriculture. Some have been made in connection with rice culture and have presented most difficult problems in some places. Some have been with people contemplating the construction of hydroelectric plants, the problem being to minimize the amount of malaria (and consequent damage suits) caused by the impounded waters. Sometimes this, too, presents considerable difficulties and may involve much work, but it is exceedingly important, and, I am sure, profitable, from a sanitary standpoint.

There is not time to discuss the research work which we have done on this problem; the statistics of morbidity we have gathered, the mere gathering of which has now and then been a factor in inducing States to make malaria a reportable disease and become interested in antimalaria measures; the blood-index work to determine the degree and the nature of the infection of communities; the problems which have come up from time to time, the solution of which was necessary to progress. I do not need to tell you who have worked with mosquitoes, how many problems of botany, of entomology, of agriculture—yes, and of geology and meteorology—come up in working out the problem of the control of mosquitoes. And besides all these, we have those in human pathology and the action of drugs in man, because the control of mosquitoes is only one of the methods of controlling malaria. Yet, I think I must mention the determination by Mitzmain,[1] of the Public Health Service, that the parasites of malaria did not live through the winter in the mosquitos which hibernate in central Mississippi.[2] This determination rendered logical the demonstration undertaken by the Rockefeller Foundation in that State which otherwise had been illogical. That all three of the common varieties of Anopheles in the eastern part of the United States are infectible with and can convey malaria has been shown by King, of the Entomological Bureau, and Mitzmain. This is a most important thing and one which we did not know before.

A study of the effects of large bodies of impounded water on the production of malaria has been carried on for the past three years. Valuable data have been secured and methods of minimizing the effect, when it exists, have been worked out and applied.

Nor is there time here to more than allude to what has been done to spread a knowledge of malaria and its control among the people. Much has been done in this matter by bulletins, leaflets, lectures, lantern slides, exhibits, etc., and it is bearing some fruit. I pin my faith, however, to two educational methods: (1) Teaching the basic facts of malaria conveyance and control in the schools of the malarious districts in order that the children may grow up with a definite and correct knowledge on this subject; and (2) the demonstration of malaria control. For the adult population there is no method of equal educational value.

---

[1] Mr. Mitzmain's name has been legally changed; it is now Bruce Mayne.

[2] Is Mosquito or Man the Winter Carrier of Malaria Organisms? M. Bruin Mitzmain. Public Health Bulletin No. 84. 1916.